Claims

1. A method of forming a diffusion hole in a fired ceramic which method comprises (i) forming a green ceramic structure from an intimate mixture of a powder of the ceramic and a binder, which structure incorporates at least one organic fibre or other organic element passing from one side of the ceramic structure to the other in a straight or non-straight path and (ii) firing the green ceramic structure at an elevated temperature to cure the ceramic and to destroy the binder and the organic fibre or other organic element.

2. A method as claimed in claim 1 in which the organic fibre or other organic element has a uniform cross section.

3. A method as claimed in claim 1 in which the organic fibre or other organic element has a non-uniform cross-section.

4. A method as claimed in any one of the preceding claims in which the binder is a water-soluble or water-swellable polymer.

5. A method as claimed in any one of the preceding claims in which, where a fibre is employed, the diameter of the hole after firing is greater than 10 microns.

6. A method as claimed in any one of the preceding claims in which, where a fibre is employed, the diameter of the hole after firing is in the range 25 to 200 microns.

7. A method as claimed in any one of the preceding claims in which, the green structure is fired at a temperature in excess of 1000°C.

8. A method as claimed in any one of the preceding claims in which the ceramic is an oxygen-ion conductor.

9. A method as claimed in claim 8 in which the oxygen-ion conductor is a 4-valent metal oxide stabilised with a three- or two-valent metal oxide.

10. A method as claimed in claim 9 in which the 4-valent metal oxide is zirconium dioxide.

11. A method as claimed in claim 9 in which the 4-valent metal oxide is cerium dioxide.

12. A method as claimed in claim 9 in which the 4-valent metal oxide is hafnium dioxide.

13. A method as claimed in claims 9-12 in which the 3-valent metal oxide is yttria.

14. A method as claimed in claim 8 in which the oxygen-ion conductor is zirconium dioxide stabilised with yttria.

15. A method as claimed in any one of claims 1-9 in which the ceramic is zirconia.

16. A method as claimed in claim 14 or 15 in which the zirconia is an yttria-stabilised cubic zirconia.

17. A method as claimed in any one of the preceding claims in which the crystalline form of the oxygen-ion-conducting ceramic is cubic.

18. A sensor which comprises a hollow cylinder with end caps enclosing an internal volume, one end of the cylinder being a sensor element comprising a disc of oxygen-ion-conducting ceramic having a porous electrode positioned at least on its internal surface and the cylinder having at least part of its structure formed of a ceramic with

at least one diffusion hole formed in its structure by the method of any one of claims 1 to 17, there being an electrical heating element able to heat the disc of oxygen-ion-conducting ceramic.

19. A sensor which comprises a hollow cylinder with end and intermediate caps enclosing at least two internal volumes, the cylinder having at least part of its structure formed of a ceramic which has one or more holes formed in its structure by the method of any one of claims 1 to 17, one end of the cylinder being a sensor element comprising an oxygen-ion-conducting disc which has a porous electrode positioned on each surface, there being an electrical heating element able to heat the oxygen-ion-conducting disc.

20. A sensor as claimed in any one of claims 18 or 19 in which the cylinder is formed of an oxygen-ion-conducting ceramic with a diffusion hole through an end or side of the cylinder.

21. A sensor as claimed in any one of claims 18 to 20 in which the disc is circular, rectangular, square or elliptical.

22. A sensor as claimed in any one of claims 18 to 21 in which the cylinder has a circular, rectangular, square or elliptical cross-section.

23. A sensor as claimed in any one of claims 18 to 22 in which the electrodes are made of a porous platinum or a porous platinum/oxygen-ion-conductor cermet.

24. A sensor as claimed in claim 23 in which the oxygen-ion-conductor in the cermet is of the same composition as that used in the green ceramic to form the electrolyte of the sensor element.

25. A sensor as claimed in any one of claims 18 to 24 in which the heating element is

in the form of resistance wires in contact with, embedded in or adjacent to the disc of oxygen-ion-conducting ceramic and an electric current can be fed to the heating element by means of platinum or other metal wires.

26. A sensor as claimed in any of claims 18 to 25 in which the heating element is a circular or square ceramic disc onto which is printed a metal film to carry the electrical current, in contact with, or adjacent to the disc of oxygen-ion-conducting ceramic or the sensor element.

27. A sensor as claimed in any one of claims 18 to 25 in which the heating element is a circular or square alumina disc onto which is printed a metal film to carry the electrical current, in contact with, or adjacent to the sensor element.

28. A sensor as claimed in any one of claims 18 to 27 in which there are two heating elements, one on either side of the sensor element, to form a sandwich construction and in which the heating elements are connected in series or parallel.

29. A sensor as claimed in any one of claims 18 to 28 in which a voltage is applied to porous electrodes which are situated on each side of a disc of OIC ceramic and the current flowing between the electrodes can be monitored.

30. A sensor as claimed in any one of claims 18 to 28 in which a constant current can be passed through the OIC ceramic disc via porous electrodes on each side of said disc and a voltage monitored.

31. A sensor as claimed in any one of claims 18 to 28 in which the electrodes on the OIC ceramic disc are on open-circuit and a voltage measured between said electrodes.

32. A method of making a sensor incorporating a sensor element which comprises (i) placing the sensor element on or adjacent to a support disc having a number of

electrically isolated conductive wires/posts passing through and fixed to it, the wires/posts being positioned in a substantially circular configuration of diameter larger than the dimensions of the sensor element with the sensor element positioned within the circle formed by the wires/posts and (ii) passing the wire/posts up the sides of the sensor element to grip the sensor element and (iii) connecting the wire/posts to electrical contacts for electrodes and for a heating element.

33. A method of making a sensor incorporating a sensor element which comprises (i) placing the sensor element on or adjacent to a support disc having a number of electrically isolated conductive wires/posts passing through and fixed to it in a non-circular configuration, the wires/posts being bent into a substantially circular configuration on the side of the support disc used to incorporate the sensor element and of diameter larger than the dimensions of the sensor element with the sensor element positioned within the circle formed by the wires/posts and (ii) passing the wire/posts up the sides of the sensor element to grip the sensor element and (iii) connecting the wire/posts to electrical contacts for electrodes and for a heating element.

34. A method of making a sensor as claimed in claim 32 in which the sensor element is placed on thermal insulating material on or adjacent to the support disc and there is at least one heating element in contact with adjacent to or forming part of the sensor element.

35. A method of making a sensor as claimed in claim 33 in which the sensor element is placed on thermal insulating material and there is at least one heating element in contact with adjacent to or forming part of the sensor element.

36. A method of making a sensor as in claim 34 in which the diameter of the circular configuration of wires/posts into which the sensor element is inserted is modified by bending each wire appropriately and then inserting thermal insulation material,

heater(s) and the sensor element as appropriate.

37. A method of making a sensor as claimed in any one of claims 34-36 in which the thermal insulation material is added in layers of discs of a single thickness or varying thicknesses, each disc being cut from sheets of uniform thickness.

38. A method of making a sensor as claimed in any one of claims 32 to 37 in which holes are cut in the discs of thermal insulation as appropriate to accommodate the sensor and heaters.

39. A method of making a sensor as in any one of claims 32 to 38 in which the wires connecting the sensor and heaters to the wires/posts run between individual layers of discs of thermal insulation material.

40. A method of making a sensor as claimed in any one of claims 32 to 39 in which the wires/posts which pass up the sides of the sensor element are bent over at the end to grip the sensor element.

41. A method of making a sensor as claimed in any one of claims 32 to 40 in which the sensor element is a cylindrical or planar sensor element.

42. A sensor made by the methods of any one of claims 32 to 41.